



TechData Sheet

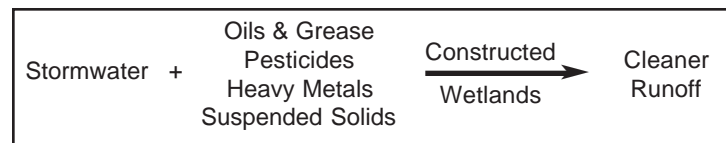
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Constructed Wetlands: Cost Effective Treatment of Non-Point Source Pollution

Constructed wetlands are man-made wetlands designed to use natural biological, chemical, and physical mechanisms to economically intercept and remove a wide range of contaminants from runoff water and wastewater. Nearly maintenance free, constructed wetlands can save the Navy money by treating non-point source (NPS) pollution before contaminants reach our lakes, rivers, and oceans.



Problem

United States Environmental Protection Agency studies have shown that more than one-third of the Nation's waters are too polluted for basic uses such as swimming and fishing. The studies point to contaminated stormwater runoff as the primary cause of this pollution. The contaminants that enter stormwater runoff largely originate from sources that are diffuse and difficult to control. Controlling NPS pollution and treating contaminated runoff are crucial to maintaining the quality of our natural resources, particularly in areas where industrial and urban development has degraded sensitive habitat. Navy bases are frequently located near sensitive habitats, such as estuaries, where water quality has been impaired.

Contaminated runoff from urban, industrial, and agricultural areas is highly variable and may include low concentrations of pesticides, metals, oils, nutrients, sediments, and other substances. The chemical and physical properties of the contaminants vary and require a multi-faceted approach for removal. Conventional wastewater treatment plants can effectively remove the contaminants, but are costly to build and operate, especially considering the high flows and low-contaminant loading typical of stormwater.

Solution

An alternative approach is to divert contaminated runoff into a constructed wetland. Wetlands remove contaminants from water through many naturally occurring biological, chemical, and physical mechanisms. In addition, wetlands require little operation and maintenance. Although many wetlands have been destroyed by industrial and urban developments, constructed wetlands can offset some of the destruction and improve water quality.

Wetlands treat contaminated water using a combination of removal mechanisms, including:

- Filtration and uptake of contaminants.
- Settling of suspended particulates due to the decreased water velocity and trapping action of plant leaves and stems.
- Biodegradation of dissolved organic contaminants and nutrients as dense populations of microorganisms in the sediment and water scavenge for food.
- Precipitation of metals and other inorganic compounds due to the reducing conditions of wetland sediment and soils.
- Photo-oxidation and physical degradation of contaminants.

Benefits

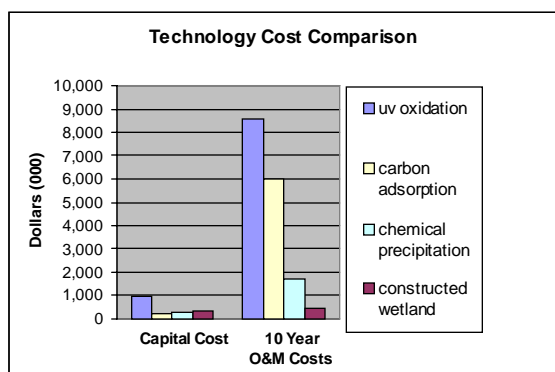
Constructed wetlands provide many benefits, including:

- Cost-effective treatment of NPS pollution
- Reduced operation and maintenance costs compared to conventional water treatment plants

- Conservation and enhancement of natural resources and creation of wildlife habitat
- Improved community relations through favorable land use goals
- Compliance with water quality goals
- Flood protection
- Aesthetic value

Cost Effectiveness

The chart below shows the cost-effectiveness of constructed wetlands. We compared a surface-flow wetland with three traditional cleanup technologies for treatment of 300 gpm wastewater containing 44 ppm total petroleum hydrocarbons. As you can see, the cost savings from treatment wetlands come mostly from reduced operation and maintenance costs.



Field Demonstration

The Naval Facilities Engineering Service Center (NFESC) constructed an innovative tidal wetland at the Naval Amphibious Base Little Creek in Norfolk, Virginia, to demonstrate treatment of NPS pollution. The wetland system consists of two adjacent 0.44 acre cells treating roughly 1.7 Mgal water per day. The cells accept water from a canal which drains into Little Creek Cove. The Cove is part of the Chesapeake Bay tidal system.



Constructed tidal wetlands, NAVPHIB Little Creek, VA

The wetland was constructed during summer 1996 and planted shortly thereafter. Approximately 20,000 salt tolerant native wetland plants were planted. Plant species include: *Spartina alterniflora*, *Spartina patens*, *Iva frutescens*, and *Panicum amarulum*.

The site is being monitored to demonstrate treatment effectiveness and determine the optimal operating conditions. The results will be used to determine applicability and feasibility of constructed wetlands at other Navy bases. The monitoring program includes: quarterly sampling, daily collection of water quality data, and stormwater sampling.

Quarterly monitoring tracks changes in contaminant levels in the wetland sediment, soils, plants, surface water, and groundwater. Pollutants assayed include organics, metals, nutrients, and BOD. Daily water quality data is collected using multiple sensor probes. These probes measure basic water quality parameters including temperature, pH, redox potential, dissolved oxygen, conductivity, salinity, turbidity, and total dissolved solids. Autosamplers collect stormwater samples during storm events with greater than 0.1 inch of rain in a half hour. Researchers from the Virginia Institute of Marine Science (VIMS) are studying nutrient accumulation and cycling in the constructed wetland sediments and comparing the results to an adjacent natural wetland.

Preliminary Results

Preliminary results and observations from the constructed wetland indicate that heavy metal contamination of site sediment is being reduced. Arsenic, lead, and chromium levels in sediment are falling while concentrations of these metals in the plants are increasing, suggesting that the plants are actively removing the metals from the soil. Contaminant levels in stormwater samples have been non-detectable to very low.

The system hydraulics are performing well. Water flows into and out of the wetland as designed on each tide cycle and check valves are performing per design. Wildlife establishment is encouraging as waterfowl, fish, blue crabs, rabbits, muskrats, and other animals have been seen.

Available Services

NFESC's Constructed Wetlands Technology Application Team is developing the tools for the Navy's Engineering Field Divisions and Public Works Centers to implement constructed wetland technologies. Services now available include: Technical consultations, feasibility analyses, design support, technical library, technical application guide, and construction and contracting support.

For Further Information, Contact

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